Gilgal & Sm

National Aeronautics and Space Administration
Goddard Space Flight Center
Contract No.NAS-5-3760

ST - ES - RA - 10 367

ON THE USE OF INDICATOR ELEMENTS FOR THE ESTIMATE OF RADIOACTIVE ANOMALIES IN THE REGIONS WITH ARID CLIMATE

by

V. M. Konstantinov

[USSR]

5 AUGUST 1965

cc

ST - ES - RA - 10 367

ON THE USE OF INDICATOR ELEMENTS FOR THE ESTIMATE OF RADIOACTIVE ANOMALIES IN THE REGIONS WITH ARID CLIMATE *

Atomnaya energiya,
Gosudarstv. komitet po
ispol'zovaniyu atomnoy
energii SSSR,
Tom 18, v. 6, 657 - 9, 1965

by V. M. Konstantinov

SUMMARY

In this paper the author demonstrates that ore anomalies in overburden may be distinguished from non-ore by the diffusion halo of indicator elements. If the sectors with ore radioactive anomalies are characterized by the presence in overburden of diffusion haloes of U, Pb, Zn, Co, Mo and As, increased content in uranium, and at times in lead, is noted in the non-ore anomaly sectors. Making use of these data, the author arrives at the conclusion, that under arid climatic conditions, the determination of indicator elements may be utilized for the diagnosis of ore and non-ore anomalies.

* * *

Practice in geological prospecting has shown that in the process of reserach, conducted by surface radiometric methods in egions with arid climate, a great number of radioactive anomalies can be traced above uranium orebodies alongside with anomalies in porous overburden. These radioactive anomalies are not connected with the uranium orebodies.

---

* O PRIMENENII ELEMENTOV-INDIKATOROV DLYA OTSENKI RADIOAKTIVNYKH ANOMALIY V RAYONAKH S ARIDNYM KLIMATOM.

As is shown by the data obtained by us, ore anomalies in overburden may be distinguished from the non-ore by the diffusion halo of indicator elements above mineralized veins.

Geochemical investigations were conducted in a region with slightly hilly relief and characterized by arid climate. According to data of a local meteorological station, only 200 mm of precipitations were recorded for the five months of the spring-summer season of 1960, with an average temperature of 19.3° (~67° F). The greater part of the said region has an overburden 1.5 – 2.0 m thick (at times up to 10 m) of porous formations, of which 5 to 20 cm constitute the soil, 1.0 – 1.6 m — the deluvium (gray loam and rubble from underlying rocks) and 0.5 – 1.0 m of eluvial deposits (crushed bedrock).

Uranium ore manifestations were revealed in the form of carbonaceous veins containing, aside from uranium minerals, some galena, sphalerite, molybdenite, chalcopyrite and, in isolated cases, cobalt, nickel and bismuth minerals. Diffusion haloes of uranium, lead, zinc, cobalt, nickel and molybdenum are formed around uranium orebodies, their width being by several factors greater than that of the orebodies.

When studying these haloes, detailed samplings were made of channels cut, uncovering the radioactive anomalies. Samples were taken every 1 – 2 m, separately of the soil, deluvium, eluvium and bedrock. The weight of each sample was of 250 – 300 g, and the quartered samples, ground to 200 mesh, were processed in a 2% soda solution. Then, the "mobile" uranium content was determined by the luminescence method. Lead, zinc, cobalt and other metals were determined by the full semiquantitative spectral analysis. The most characteristic metal content in the given diversified formation was taken for the value of the geochemical background (see Table).

It was established that the indicator elements form diffusion haloes around uranium-mineralized veins in bedrock as well as in the overburden. The width of these uranium haloes exceeds by 15–20 times the thickness of the ore veins. The concentration of uranium in the overburden is maintained in most of the radioactive anomalies the same as in primary halo, or decreases somewhat (see Fig. 1). In isolated cases the concentration of uranium in the soils exceeds significantly its content in the primary diffusion halo and drops to the background value in deluvium.

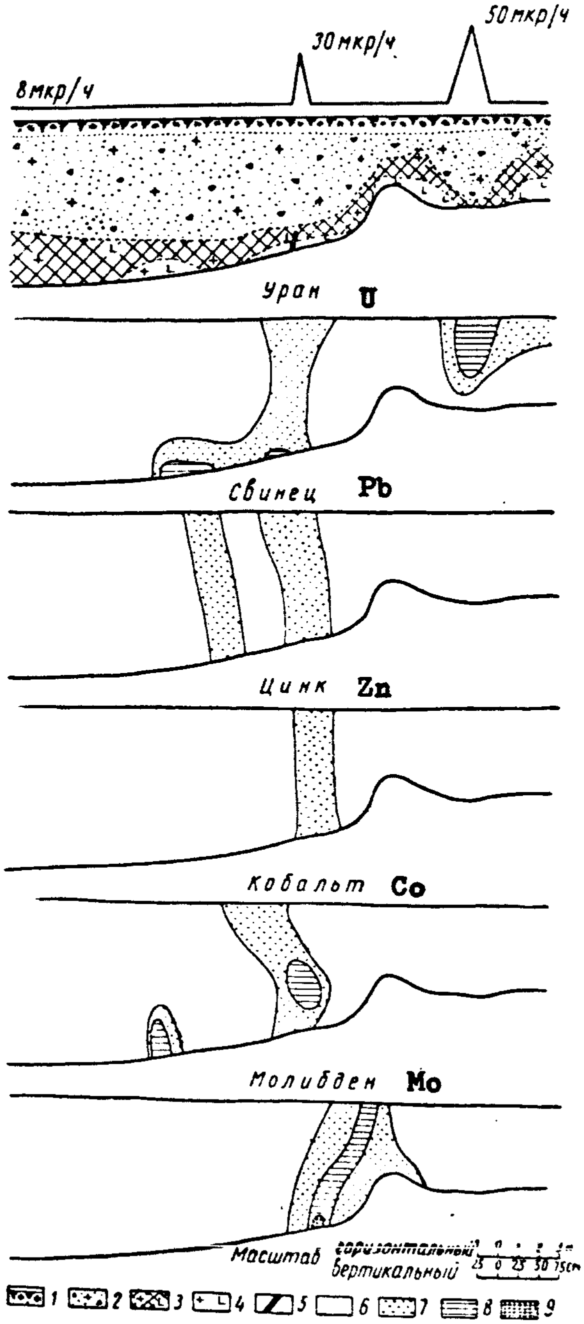

Fig. 1. - Distribution of chemical elements in a sector with radio-active anomalies:

1 - soil; 2 - deluvium; 3 - eluvium ; 4 - granodiorites; 5 — ore vein ;

Chemical element content in geochemical backgrounds :

6 - to 3 gb; 7 — 3÷10 gb; 8 — 10 ÷ 30 gb ; 9 — 30 ÷ 100 gb; —— curve for γ - activity.

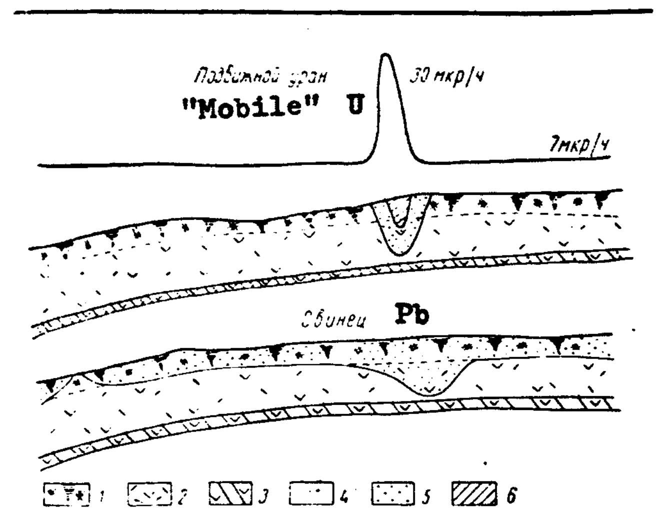

Fig. 2. - Distribution of "mobile" U and Pb over a sector with non-ore anomalies:

1 - soil ; 2 — deluvium ; 3 — bedrock;

Element content in geochem. backgrounds

4 — to 3 bg; 5 — 3 — 10 bg; 6 — 10 ÷ ÷ 30 bg; —— curve for γ-activity

TABLE

MAGNITUDE OF ELEMENTS' GEOCHEMICAL BACKGROUND*

Element	sensitivity of the meth. weight %	GB weight %
U ("mobile")	0.00001	0.000018
Pb	0.001	0.001
Zn	0.01	Trace (0.01)
Co	0.001	0.001
Mo	0.0003	Trace(0.0003
As	0.01	0.01

* The data were obtained from the conducting of 260 analyses.

Lead, zinc and molybdenum form diffusion haloes, whose width in overburden exceeds sugnificantly the thickness of ore veins (Fig. 1). In separate areas the width of the diffusion haloes of lead in deluvium and in soils remains invariable or decreases somewhat. In overburden the diffusion haloes of cobalt yield somewhat to those of other elements. There the cobalt content either remains invariable by comparison with the primary halo or increases somewhat in eluvium (see Fig. 1).

In one of the channels sampled, where aside from uranium minerals a substantial amount of sphalerite and galena was included, a clear arsenical halo was established in bedrock and overburden. Its width was found to be 8 — 10 times greater than that of the ore vein. However, in the soil layer a sharp increase of the diffusion halo was observed with decrease in arsenic content.

Therefore, in sectors with ore radioactive anomalies in overburden diffusion haloes of uranium, lead, zinc, cobalt molybdenum and arsenic are observed, that is, of those chemical elements that form also endogenic diffusion haloes. Inasmuch as the chemical properties and the migration capability in the hypergene zone of these elements in arid climatic conditions are very distinct, the coincidence of their haloes in soils, pointing to the absence of significant loss, allows to assume that they formed mostly as a result of weathering.

Over sectors of non-ore radioactive anomalies, the upper layers of the cross section of overburden formations (soil, deluvium) are characterized in most of the cases by increased uranium concentrations (Fig. 1, 2). It should be noted that the maximum content in uranium, is ascribed to the soil layer and it often exceeds the uranium content in the ore anomalies. Moreover, there is in the sector of non-ore anomalies an insignificant amount of lead. The increased lead content in the soil layer is sometimes observed also in non-radioactive anomalies.

Some of the non-ore radioactive anomalies are insignificantly remote from the orebodies. However, in most cases no connection of any sort is observed between them and the primary uranium mineralization. Obviously, these non-ore radioactive anomalies have formed as a consequence of migration, and the precipitation of uranium from ground water.

At the same time, either the uranium-mineralized veins or rocks without significant amounts of uranium could have been the source of uranium.

Therefore, if the sectors with ore radioactive anomalies are characterized by the presence in overburden of diffusion haloes of U, Pb, Zn, Co. Mo. As, only an increased content in uranium and sometimes in lead is noted in the non-ore anomaly sectors. Under arid climatic conditions the determination of the indicator elements of uranium mineralization may be utilized for the diagnosis of the ore and non-ore anomalies.

*** THE END ***

Received on 1 April 1965

NO REFERENCES

Contract No. NAS-5-3760
Consultants and Designers, Inc.
Arlington, Virginia

Translated by ANDRE L. BRICHANT
on 4 August 1965

DISTRIBUTION

GODDARD SPACE F.C.

100	CLARK, TOWNSEND
600	STROUD
610	MEREDITH
611	McDONALD, ABR.BOLDT
612	HEPPNER, NESS
613	KUPPERIAN
614	LINDSAY, WHITE
615	BOURDEAU, BAUER
640	HESS [3]
	O'KEEFE
660	GI for SS [5]
252	LIBRARY [3]
256	FREAS

NASA HQS

SS	NEWELL, NAUGLE
SG	MITCHELL
	SCHARDT
	DUBIN
SL	LIDDEL
	BRYSON
	FELLOWS
	HIPSH, HOROW.
SM	FOSTER, ALLENBY
	BADGLEY, GILL
RR	KURZWEG
RTR	NEILL
ATSS	SCHWIND [4]
	ROBBINS
WX	SWEET

OTHER CENTERS

AMES

SONETT [5]
LIB. [3]

LANGLEY

213 KATZOFF
185 WEATHERWAX [2]

JPL

SNYDER
SPEED
CONEL
KOVACH
LOOMIS

UCLA

COLEMAN

UC BERKELEY

WILCOX

AGI.

RUSSEL